Salal Complex

This operational summary provides information about vegetation management in the salal complex. This complex is almost completely comprised of salal (*Gaultheria shallon*). Herbaceous and other shrubby species constitute only a very minor component of this complex.

Topics covered in this summary include development of the complex and its interaction with crop trees; non-timber values and pre-harvest considerations; and management strategies for current and backlog sites.

Other Titles in this Series

Operational Summary for Vegetation Management:

- Bigleaf Maple Complex
- Cottonwood Complex
- Dry Alder Complex
- Ericaceous Shrub Complex
- Fern Complex
- Fireweed Complex
- Mixed-shrub Complex
- Pinegrass Complex
- Red Alder–Salmonberry Complex
- Reedgrass Complex
- Wet Alder Complex
- Willow Complex

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Operational Summary for Vegetation Management

Salal Complex

BRITISH COLUMBIA

Forest Practices Branch
Ministry of Forests

FOREST RENEWAL BC

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Operational Summary for Vegetation Complexes
Salal Complex

Foreword

Managing competing vegetation during reforestation can be challenging. Combinations of plants that thrive in seral ecosystems often dominate sites following harvesting or natural disturbance. While many treatment methods for limiting the growth and spread of these vegetation complexes have been explored, the effectiveness of these treatment methods varies widely. This is due to a varying mix of factors, including the number, health, and structure of the competing plants on site, site conditions, treatment timing, and impact of forestry activities. In addition, while some treatments may provide suitable control, the cost in terms of site degradation, hazard to surrounding habitat or crop trees, or the cost of the treatment itself, may be prohibitive.

Much work has been undertaken in recent years by ecologists, silviculturalists, and vegetation management specialists in identifying the characteristics of, and the range of treatment options for, major competing vegetation complexes. Until recently, however, knowledge about managing particularly challenging vegetation complexes was scattered. This series summarizes the key information needed to identify and manage important vegetation complexes in British Columbia.

Introduction

Each complex includes several plant species and may be found over a wide range of ecosystems. As a result, response to treatments will vary within complexes, and prescriptions should be developed on a site-specific basis. This operational summary provides information about vegetation management issues in the salal complex. Topics include: complex development and interaction with crop trees; treatments that affect development of the complex; non-timber and pre-harvest considerations; and management strategies for current and backlog sites.

1. Description

Species Composition

This complex is almost entirely comprised of salal (*Gaultheria shallon*). Once a salal complex develops, few other species can establish or survive in this association. Herbaceous and other shrubby species constitute only a very minor component of the salal complex.

Occurrence

Salal grows throughout coastal British Columbia in lowland coniferous forests and in open shoreline habitats such as bluffs and rocky knolls.

While salal is most commonly found on nutrient-poor, slightly dry to moist sites, it is relatively insensitive to nutrient or moisture levels. Salal will grow on a range of moisture and nutrient conditions in both mineral and organic soils. However, in the Coastal Western Hemlock (CWH) dm, mm1, and xm subzones, salal gains its greatest site domination on moderately to slightly dry sites, and in the CWH vh1, vh2, vm1, vm2, and wh1 subzones, site domination by salal occurs on slightly dry to very moist sites. In all of these cases, nutrient status is poor to medium. In the Coastal Douglas-fir (CDF) mm, salal can dominate moderately dry, nutrient-poor to -medium sites.

2. Complex Development

Reproduction

Heavy crops of salal "berries" are produced on a regular basis under medium to full light conditions. Under low light conditions, very little to no fruiting occurs. Salal fruit can remain on the plant for a considerable length of time, and as long as the fruit remains on the plant, the seed it contains will remain viable.

Salal seed will germinate under partial shade and full light conditions but establishment of the resultant seedlings is best under partial shade. Seedling production is not significant in perpetuating established salal colonies.

Vegetative reproduction is the primary means of expansion and perpetuation of established colonies. Salal can reproduce through layering and sprouting from rhizomes and stem bases. Buried stem and rhizome fragments can be expected to re-establish new shoots following soil disturbance. Individual plants can survive for an indefinite period due to continued re-sprouting.

Rate of Development

Development of salal plants from seed is initially very slow. Established salal plants, in most cases, do not have substantial yearly height growth. The average plant height is between 60 to 120 cm; however, some plants, under optimal conditions, can exceed a height of 2.5 m. Salal is usually taller when growing in partial shade than when growing in full light. Although salal is a relatively short plant, its actual biomass production is considerable. The total belowground biomass of a salal colony typically exceeds the weight of the aboveground parts.

Factors Affecting Development

The majority of salal complexes are established under natural circumstances prior to canopy removal. Salal does not grow as rapidly as many other shrub species and may take several years to become dominant following disturbance or its removal. However, once the salal complex is established, it is very long-lived and few other plant species can readily colonize and out-compete it. Therefore, desired crop trees should be established promptly prior to full salal complex development.

Treatments or factors favouring the re-development of the salal complex include:

- increased light levels created as a result of harvesting or natural disturbances
- ground disturbances which sever and bury rhizome and stem fragments
- light to moderate burning.

Treatments or factors that can impede or delay the development of the salal complex include:

- heavy shading
- very intense burns
- dry site or soil conditions
- vegetation control with herbicide, for example:
  - triclopyr ester applied as a foliar spray in early spring or late summer.

Interactions with Crop Trees

Salal provides serious belowground competition for moisture on dry sites and nutrients on all sites, it inhibits the mineralization and uptake of nitrogen through the production of tannins, and it interferes with the mycorrhizal associations of some crop trees. Salal competition is most severe during the early stages of stand development. However, competitive impacts may continue through the rotation if the overstorey canopy is open enough to allow salal to persist. When salal achieves domination of the site, the established crop trees become chlorotic and growth slows down dramatically. The latter condition occurs approximately 5 to 8 years after harvest and broadcast burning,

The primary beneficial effect of salal is the contribution of organic matter to the soil. Other beneficial effects of salal may be the control or reduction of soil surface erosion and the exclusion of other competitive species.

3. Management Consideration for Other Resource Values

The leaves, twigs, blossoms, and berries of salal are all consumed by a variety of wildlife species. Salal leaves and twigs are important winter forage for deer, mountain beaver, and elk. Ruffed and blue grouse will consume the buds and blossoms. Several small mammals and birds as well as bear, deer, and red squirrel all consume salal berries.

Salal stems and leaves are used extensively in the floral industry.

4. Pre-harvest Considerations

Silvicultural System

Salal will increase in cover and vigour when the overstorey canopy is reduced or totally removed. The belowground recovery of salal with increases in light intensity is relatively quick. The aboveground portion,

however, may take several years to dominate the site. Whereas the cover of salal tends to increase with increasing light intensity, the height growth decreases with increasing light intensity. Thus, under partial canopies, the coverage and height of salal may be small and greatest, respectively.

Under very low light levels (5–10% full light), rhizome production by salal is severely reduced or stopped and all plant energy is directed at maintenance of the aboveground portion. Salal may be excluded from sites with very dense closed canopies. Salal plants growing in canopy gaps, however, may aid the survival of plants growing under very low light levels through root and rhizome connections.

Silvicultural systems that employ some canopy retention resulting in moderate shading of the site (e.g., shelterwood, seed tree) may result in a marginally reduced salal cover but may also result in increased salal height. Silvicultural systems that create larger canopy openings and higher light levels (e.g., clearcut, patch clearcut, retention) may result in increased site occupancy by salal but may also result in reduced salal height. Regardless of the silvicultural system used within this complex, consideration must be given to future vegetation and site management strategies aimed at reducing the competitive impacts of salal.

Advanced Regeneration

The retention of advanced regeneration may reduce some of the competitive impacts of salal. Advanced regeneration of sufficient size may have a root network that is able to withstand or minimize belowground competition with salal for water or nutrients. High levels of advanced regeneration may also encourage rapid crown closure, thus speeding the exclusion of salal from the site.

Method of Reforestation

On sites with minor understorey densities of salal prior to harvest, natural regeneration of Cw and Hw in the wetter CWH subzones could be considered an option due to the slow development of the salal complex. However, where understorey densities of salal are moderate to high, or in drier BEC zones and subzones, natural regeneration may not result in sufficient stocking before the majority of crop tree seedlings are large enough to withstand the competitive impacts of salal. Crop tree seed falling beneath a low continuous salal canopy may not have enough light to germinate and any seedling that does germinate may suffer from severe competition for water or nutrients.

Salal does not rapidly dominate the aboveground portions of a site but, depending on the pre-disturbance salal density, the belowground competition can be immense and its onset can be relatively immediate following disturbance. Therefore, planting has been determined to be the most effective means of rapidly establishing a crop of desired trees. Planting allows the crop tree seedlings to rapidly develop a root system and achieve a height to effectively compete with salal.

5. Vegetation Management for Current Sites

Site Preparation

General

Any soil disturbance that causes damage to existing salal plants may promote re-sprouting and the spread of rhizome and stem fragments.

Mechanical

Light- to medium-impact mechanical site preparation treatments such as spot mulching and disc trenching can create conditions that slow the aboveground domination by salal. Treatments that destroy existing plants while exposing and mixing the upper mineral horizons may sever and spread salal rhizomes and stem fragments throughout the treatment area. These rhizome and stem fragments will slowly establish new plants, effectively slowing the rate of development of the salal complex and extending the reduced competition window by 1 to 3 years.

High- to very high-impact mechanical site preparation can control the establishment of salal if the roots, rhizomes, and stem fragments are removed from the soil. In most cases, complete removal of all portions of the plant is not possible. The result, however, is that salal re-occupation of the site may be dramatically slowed, allowing for the crop trees to gain sufficient height and crown closure to offset the competitive impacts of salal once it does re-occupy the site.

On wetter sites, heavy equipment must be used in a manner that does not damage natural drainage patterns, cause soil compaction, or create unproductive wet depressions.

Manual Scalping (Screefing)

Similar to light mechanical scarification, planter patch (30 cm × 30 cm) screefing may provide only a very short competition-free window. Disturbance and destruction of existing salal plants may result in only a short period of reduced competition. The plants arising from the severed pieces tend to quickly establish themselves while the scarified soil patches are also colonized by roots and rhizomes from plants on the perimeter of the patch.

Prescribed Fire

Light to moderate burning has been found to have little damaging impact on existing salal plants. The aboveground portion of the salal may be killed by fire but the belowground rhizomes may be little impacted. Shoot re-growth from the rhizomes may increase the coverage of salal over that which was present prior to treatment. However, this recovery is slow and it may take a few to several years to achieve pre-burn levels of aboveground site occupancy. Only very intense burns that consume the majority of the organic layer, rhizomes, and roots have been found to be effective in controlling salal. Impacts on nutrient availability have to be considered when employing very intense burns as they may reduce the long-term availability of nitrogen on the site.

Chemical

Chemical treatments have had variable success rates in controlling salal. Foliar applications of glyphosate results in only light to moderate damage on salal plants. Triclopyr ester (4 kg ae/ha) applied in mixture with diesel oil at a rate of 100 l/ha, however, can significantly reduce the aboveground cover and competitive effects of salal. Application of triclopyr ester with mineral oil or other carriers has not been reported to give as effective control of salal. Hexazinone has had inconsistent results in controlling salal, often described as ineffective but with some reports of good control.

Seeding with Cover Crop Species

Unless salal rhizomes or established plants are absent from the site, seeding of agronomic species may be ineffective since salal may be able to out-compete the agronomic species and dominate the site.

Biological Control

Livestock Grazing

Salal has low palatability and is not favoured by livestock.

Other

Numerous diseases are known to occur on salal with the most common being leaf spot fungus (*Mycosphaerella gaultheriae*). In the southern portions of British Columbia, the grey weevil causes severe leaf damage to salal. However, neither of these agents is available for operational control of salal.

Planting

Timing

In order to take full advantage of the window of reduced competition, crop tree planting should occur immediately after harvest or site preparation. The longer the salal complex can develop prior to crop tree establishment, the lower the success rate of reforestation efforts. Plantations should be established prior to site domination by salal.

Stock Type

Large (415D or greater) vigorous planting stock with well-developed root systems can improve seedling survival on salal sites. Seedling stock types that can establish and begin growing quickly following planting are likely to become established as crop trees.

Species Selection

Western redcedar and western hemlock are the preferable crop species on moist CWH sites (vh1, vh2, vm1, vm2, and wh1 subzones). However, western hemlock does not grow well when competing with salal and should be used only on sites where subsequent fertilization is planned. Yellow-cedar may also be suitable on some sites and grows as well as western redcedar. Western redcedar will grow at acceptable rates without fertilization within the salal complex. However, if planted alone, it may not have enough crown closure to effectively exclude salal from the site except at very high densities and, due to the low nitrogen content of its litter, it may perpetuate nitrogen supply problems encountered on these sites.

Therefore, western redcedar should be planted in combination with other species.

Douglas-fir and western redcedar are more suitable on the CDF and the drier CWH sites (dm, mm1, and xm subzones).

Fertilization

Appropriately prescribed fertilization, at the time of planting, has been shown to promote establishment of crop tree seedlings. Fertilizer formulations that promote crop tree root and shoot growth may allow the seedling to develop structures that are better able to compete with salal for resources. Fertilizer application may also reduce the amount of time to crown closure facilitating exclusion of salal from the site.

Planting Density

In order to facilitate rapid crown closure and the exclusion of salal from these sites, high density planting (1400–1800 stems/ha) is recommended.

Brushing

General

The need for brushing treatments will depend largely on the success and timing of the initial planting. Since salal is able to re-occupy a site from underground rhizome and stem base re-sprouting, few brushing techniques will provide anything but short-term competition relief.

Manual

Manual cutting of salal stimulates re-sprouting from stem bases and rhizomes, usually resulting in an increase in salal crown closure on the treated site. To be effective, manual cutting is required for several consecutive years.

Chemical

As described under "Site Preparation (Chemical)," chemical treatment has had variable success in controlling salal. Currently, however, there are no effective herbicide treatments that control salal without causing serious damage to any oversprayed conifer.

Physical Barriers (Mulches)

Large (90 cm × 90 cm) plastic mulches, when firmly anchored to the ground, can provide a microsite free of the aboveground portions of salal for up to 2 years. Very little impact on the belowground portions of the salal plant will occur with this method.

Livestock Grazing

As described under "Site Preparation (Biological Control)," salal is not favoured by livestock. Hence grazing may not be effective.

6. Vegetation Management Strategies for Backlog Sites

General

The same vegetation management strategies employed on current sites can be applied to backlog sites since there is little difference between the complex on current and backlog sites.

Thinning

Stand thinning that reduces the overstorey canopy to below 80% crown closure may create conditions favourable to salal growth. The increase in light penetration resulting from thinning may stimulate the growth of understorey salal and could result in increased salal competition in the next rotation.

Fertilization

Though salal may respond to fertilizers, particularly nitrogen, with increased aboveground and belowground growth, the effects are slow to appear. Fertilizer application can increase the crown closure and canopy density of the desirable tree species and may result in lower salal coverage on the site because salal will be shaded out. Repeated applications of fertilizer (200–300 kg N/ha and 50–100 kg P/ha) may be necessary to achieve crown closure and reduce salal occupancy. Sites should not be broadcast fertilized until the crop trees are large enough to capture the majority of the applied fertilizer.

7. Summary

Reduction of the competitive impacts of the salal complex must begin with proper site identification and recognition of the potential for complex development. All subsequent treatments must consider the potential growth response of the complex under the resulting microsite environment. The success of any treatment will depend on its impacts on both the aboveground and belowground portions of the salal plant. The efficacy of several treatments also depends on the density and coverage of salal prior to harvest or treatment. In order to reduce salal competition and increase soil moisture and nutrient availability, the primary vegetation management objective should be the rapid development of a closed crop tree canopy. Once a closed canopy condition is achieved and salal is mostly excluded from the site, crop tree growth should improve.

When crop tree establishment is delayed and the salal complex becomes well established, the effectiveness of all potential vegetation control methods decreases. The most successful way of establishing a plantation in this plant community is prompt initiation of reforestation activities after disturbance.

When pre-harvest salal coverage is low, high density planting alone may be an effective non-chemical strategy that may provide crop trees with sufficient time to establish before full site occupancy by salal. When pre-harvest salal coverage is moderate to high, an effective system of non-chemical treatment may start with a moderate to high intensity prescribed burn followed by an immediate planting of large vigorous stock types of a fast-growing species. Alternatively, a patch scarification treatment that creates large well-mixed planting spots may be used as a site preparation treatment instead of a prescribed burn.

Herbicide control of salal has had varying degrees of success. Application of fertilizers with the crop tree seedling at the time of planting and subsequent fertilization of established crop tree stand may be a management option in this complex.

The use of a combination of both chemical and non-chemical strategies has been shown to be effective in managing sites that currently have, or have the potential to develop, the salal complex. Such strategies may include the following three-stage treatments:

1. prescribed burning or patch scarification of the site immediately after harvest
2. an immediate planting of a fast-growing crop species incorporating individual seedling fertilizers with each tree
3. if necessary, application of appropriate fertilizers approximately 5 to 10 years after planting.

The site preparation treatment would depend on the pre-harvest coverage of salal; if it is low, this step could be avoided. As well, undertaking the later fertilization treatment would depend on the crown closure and vigour of the developing crop tree stand; if it has a high crown closure and good vigour, then this step may not be implemented.

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